



IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Application

Inventors: DeOrnellas, et al.

Application No.: 09/692,007

Confirm. No.: 7175

Filed: October 19, 2000

Title: **METHOD FOR USING A HARD MASK FOR
CRITICAL DIMENSION GROWTH
CONTAINMENT**

PATENT APPLICATION

Art Unit: 1765

Examiner: L. Umez Eronimi

Customer No. 23919

DECLARATION UNDER 37 C.F.R. § 1.131

Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Sir:

I, Stephen F. DeOrnellas declare as follows:

1. That I am a named inventor in the above-referenced U.S. Patent Application No. 09/692,007, hereinafter cited as the '007 application.
2. That I am a named inventor in U.S. Patent 6,287,975 filed January 20, 1998, to which the '007 application claims priority.
3. That I have reviewed the latest claims describing the invention in the '007 application that were filed with an Office Action Response on April 16, 2004.
4. That attached lab notebook entries include: (1) pages 77, 78 and 81-83 from the lab notebook of Kurt Olson, an employee of Tegal, the assignee of the '007 application (hereinafter the Olson notebook); and (2) pages 53-100 from the lab notebook of Alford

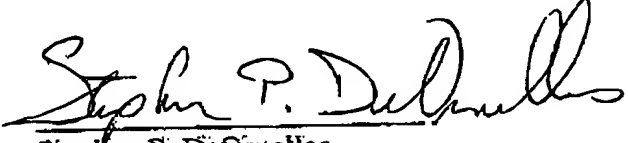
Cofer, a co-inventor of the '007 application and employee of Tegal (hereinafter the Cofer notebook). Note that some information has been redacted from both the Olsen and Cofer notebook entries.

5. That the Olsen lab notebook entries were witnessed by Lance McCullough (an employee of Tegal) and Kurt Olson, and were made at my direction and with my knowledge at the time the entries were made. Further, the Cofer notebook entries were made at my direction and with my knowledge at the time the entries were made.
6. That I believe the lab notebook entries show conception of and reduction to practice of the claimed invention in the '007 application prior to January 20, 1997, a date one year before the earliest priority date of January 20, 1998 for the '007 application. I believe conception before January 20, 1997 is shown at least by pages 77, 78 and 81 of the Olsen notebook, with page 77 illustrating the conception of the hard mask, with page 78 illustrating etching in the presence of fluoride and adding energy in the form of temperature at 180-300 degrees Celsius, with page 77 illustrating the concept of etching in a stream of oxygen, and page 81 illustrating the hard mask in one embodiment to be titanium. I believe reduction to practice is shown as early as January of 1997 by data for a process performed on page 83 of the Olsen notebook, in particular the process is described using a hard mask with a process temperature of 75 degrees Celsius.
7. Further, I believe the lab notebook entries show diligence from conception before January 20, 1997 until filing of the present application on January 20, 1998. Conception is shown prior to January 20, 1997 as evidenced in the Olsen notebook indicated above. Diligence (as well as further reductions to practice) is shown from at least May of 1997 through January of 1998 by pages 53-100 of the Cofer notebook.

8. That the above statements were made with the knowledge that willful false statements and the like are punishable by fine and/or imprisonment, or both, under Section 1001 of Title 18 of the United States Code, and that any such willful false statement may jeopardize the validity of this application or any patent resulting therefrom.

12-28-04

Date


Stephen P. DeOrnellas



IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Application

Inventors: DeOrnellas, et al.

Application No.: 09/692,007

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Filed: October 19, 2000

Title: METHOD FOR USING A HARD MASK FOR
CRITICAL DIMENSION GROWTH
CONTAINMENT

PATENT APPLICATION

Art Unit: 1765

Examiner: L. Umez Eronini

Customer No. 23910

DECLARATION UNDER 37 C.F.R. § 1.131

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Date

Stephen P. DeOrnellas



Lab Notebook

of

Kurt Olson

Dated: -----

**pages 77, 78 and 81-83
(Dated through January 20, 1997)**

Hard Mask0.40 ^{pitch}

Line Space 4 Wafers

0.36
pitch

Line Space

1 wafer

Many

(Maybe already Done By Fab)

OE

① ~~2 mT / 500 / 100 80% O₂~~ 40% 70%② → 2 mT / 400w / 100 80% O₂ 40 70%

③ ? Equal

④ ?

① → 2 mT / 500 / 100 80% 40% 70%

Wavelength #4

814 nm

Argon/Cl₂

Mr. Nam

Wanted.

1 wafer

Continued on Page _____

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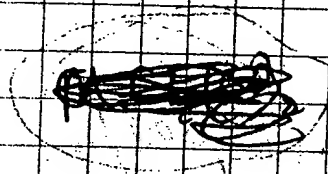
Date

To Etch Platinum or other similar non-volatile metal
for Patterning small dimensions or Pt removal from
etch chamber surfaces or prevention of Pt deposits on chamber
Create the compound $PtCl_2(PF_3)_2$ by feeding

Cl_2 and (PF_3) or Cl Donor and (PF_3) donor
into a plasma reactor

$PtCl_2(PF_3)_2$ is known to be volatile @ $\sim 180-300$
(and stable)

Reference to Article by Chatt, J. in
Nature V.165 April 22 1950



Continued on Page _____

Art. New 4/6/97
Signed

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Lucy M. Hach

1/7/96

~~16 PATTERN~~
16 Patterned Resist 96291 P For Deposit/Volatile Product
8 EOR
8 HardMask wafers 963374
8 Patterned TEST 961782p Bids Vail
10 Blanket Pt 963031 P
~~6 Pts~~
12 blanket Ti (300Å) over SiO₂ (1000Å)

Continued on Page _____

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→ Try New Process on Hm.

1) $20\text{ Ar} / 2\text{ Cl}_2$

Enter Start He 80/80

60 Ar / 2 Cl₂

Test Linearity of Cl₂

Valve 5% Fixed

Flow
SET

2 3.5 → 3.5

4 7.6

8 15.9

10 (Read 1.5) 2.5

0 (Read 0) 0.2

Pressure
in

3
2
1

3.5

flow
Cl₂

@ low Cl₂
use Readout for Cl₂ Flow
Not Set

8/60

2)

60 Ar / 2 Cl₂

Cl₂ Reads 1.9

- 28 sec He Fault Stop Restart Orange Plasma
+ 211

30 0.2 in Center? past exposure of Ti

3)

20 Ar / 7 Cl₂ Partial Etch

51 sec Etch

more Gray Plasma

Continued on Page

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KAO

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1/9/97

Date

Signed

Date

1/20/97

hardmask (recipe name)

> 60 Ar / 4 Cl₂ / time 150 < X < 240 (recipe #s) 500/120 Watts
 check He fault bands
 terminate whenever Pt just clears
 cleave left to right request dense & end of array & field end of array
 profile

| slot | type | He flow | Valve | EP | Time | notes |
|------|------|---------|-------|------|------|---|
| 1 | Si | 3.6 | 24.4 | 2.1 | 65 | 75°C/75°C |
| 2 | HMI6 | 3.2 | 25.1 | 46.5 | | Start - He flow = 2.9 sccm OOPS 158 + 119 = 269 s could not see endpt. file name 20-Jan 10:51am lot 40 wfr. 2 |

Clean window (vent w/ N₂ & keep N₂ on) leak rate < 7/mbar

| | | | | | | |
|---|-----|-----|------|------|-----|--|
| 1 | Si | 3.7 | 24.5 | 46.4 | 62 | endpt. file name 20-Jan 1:22pm lot 41 wfr. 2 |
| 2 | HMI | 3.4 | 25.5 | 52.0 | 123 | meas. Oxide thickness = 1370 Å |

Submit to SEM

probe - 9 Cl₂/20 Ar 500/100 probe @ reactor temp.

Continued on Page _____

140 sec (to end pt.) plus 30 sec. into SiO₂
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Signed _____

Date _____



Lab Notebook

of

Alferd Cofer

Dated: December 13, 1996 through January 1, 1998

pages 53-100

(Dated May 14, 1997 through December 4, 1997)

Appo 1 - PM 4.

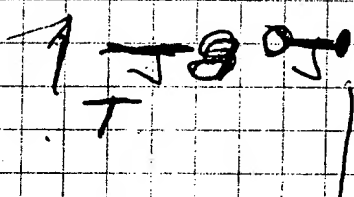
5/14/97

at 40°C 1°A chuck-up

38.9 out 39.9 10 Wafer Elect
145 pF chuck up 5: wf Chamber 75°10A₁/10C₂

10° 10.7 mD 19.2 mD.

$$Q = \frac{L}{R}$$

↑  Install date
T-match -

5/15/97

40A₁/10C₂/200W

| | RF A | RF on | Δ |
|-----|---------|--------------------|----------|
| 10° | 11.0 mD | 10.4 | - .6 |
| 18° | 5.1 mD | 5.0 4.8 | - .3 |
| 40° | 2.0 mD | 2.1 | + .1 |

- 760 V 500W 5 mD, 20/10 C₂- 1480
(500/200)

Continued on Page

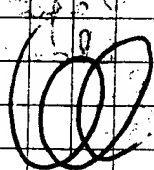
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Date

Signed

Date



CR. (1.53)

Wf

(1.73)

~~1.73~~

75° 4.2% 42° 3.3% min.

| | | | | | |
|-----|------|---------|------|------|---------|
| | 6:40 | | 39.3 | 39.9 | 1.7 GPM |
| | 6:50 | 75°/49° | 44.6 | 45.6 | 1.7 GPM |
| 55° | 7:00 | 75°/56 | 51.1 | 52.0 | 1.7 GPM |



$$500W = \frac{E^2}{R}$$

25000

3.2 Arms
158 Vrms 500W

Continued on Page

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Date

PROJECT _____

Continued From Page _____

Eng Probe 1160 ~~1350~~ V 427 V RMS
32.0 34.4 A 9.7 RMS SN#24

Process 1900V ~~2020~~ V 492 RMS
27.2A ~~28.8~~ A SN#33

1600 440 V RMS

| | V | RMS | A | RMS | |
|------------|-----|-----|------|------|-------|
| 500 W 10μs | 480 | 156 | 8.00 | 2.62 | 8N 33 |
| 5μs | 480 | 154 | 8.00 | 2.61 | |
| | 480 | 156 | 8.00 | 2.65 | SN 24 |

AV Probe 496 174
20MHz BW 448 154

| | 20 MHz | 60 MHz |
|-----|----------|-----------|
| #33 | 1220 340 | 1860 485 |
| | 25.2 8.6 | 27.2 9.74 |

Continued on Page _____

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Date _____

Signed _____

Date _____

90° 0 5 cm 1 mb

| | | | AL | CL | RF |
|------------------|---------|------|------|----|-----|
| 90° | 1.6 mb | | " | " | " |
| 40° | 2.3 mb | 37.5 | 12.5 | 0 | |
| 18° | 5.4 mb | " | " | " | " |
| 10° | 11.8 mb | " | " | " | " |
| $\Delta - .3 mb$ | 10° | 11.5 | " | " | 700 |
| $\Delta + .6 mb$ | 18° | 6.0 | " | " | " |
| $\Delta + .2 mb$ | 40° | 2.5 | " | " | " |

100

1 V
1 V

2.3 V
1.5 V

(3. mb)
(1.5 mb)

10°

11.5 mb

700 W
11.3

500 W
11.0

300 W
10.9

1 V offset

18°

5.4 mb

500/100
12.3
500/200
11.5
500/0
10.8
500/0
5.7 mb
500/100
7.1 mb
500/200
6.0 mb
5.4 mb

5.4 mb

Continued on Page
5.4

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PROJECT _____

Continued From Page _____

(190 kHz 5.2 ps Pressure Turbo 8)

| | | |
|------|--------|----------|
| 73.0 | - 74.1 | 0 power |
| 72.3 | 73.5 | 500W |
| 73.2 | 74.6 | 2500/200 |
| 72.8 | 73.6 | 0 power |

| | |
|------------|----------|
| 72.6 | 76 Ch |
| 73.2 | 78 Elect |
| | 5.8 l/m |
| | 3.4 l/m |
| 79 Chiller | |
| 1.75 BHP | |

| | | | | | |
|-------------------------------|-----|---------|--|--------|--------------|
| A ₁ Q ₂ | | 0 W | | 700 W | |
| 37.5/12.5 | 10° | 10.0 mV | | 8.5 mV | 1.7 V 40 kHz |
| | 18° | 4.7 mV | | 4.5 mV | 1.6 V " |
| | 40° | 2.0 mV | | 2.2 mV | 1.8 V " |
| | 90° | 1.2 mV | | | |

Continued on Page _____

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Date _____

Signed _____

Date _____

| | 700W | 5W |
|-----|----------------------------|-------------------|
| 10° | 7.5 mV / .5V _{pp} | 10.3 mV |
| | No RF | RF on |
| 10° | 11.2 1.16V | 9.1 mV 1.18V .68V |
| 18° | 5.3 .56V | 4.8 mV .74V .24V |
| 40° | 2.3 .24V | 2.2 mV .46V -.04V |
| | RF | No |
| | 10.2 11.7 | |
| | 5.6 5.5 | |
| | 2.7 2.4 | |

| | | | | |
|-------|-------|----------------------|-------|---------|
| SN#28 | → 28A | 1220 V _{pp} | @500W | 12.6 NS |
| SN#35 | 28.4A | 1110 V _{pp} | @500W | 17.2 NS |
| SN#24 | 32.0A | 1160 V _{pp} | | |
| SN#33 | 27.2A | 1900 V _{pp} | | |

| | | | |
|------------------|-----------|-----------|--------|
| | 37.5/12.5 | 5 mV 700W | |
| For 148V .27 10° | 12.4 10.4 | 9.7 mV | 9.0 |
| | 5.7 120W | 4.6 mV | 5.2 58 |
| | 2.6 .14V | 2.4 | 2.5 |

Continued on Page

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Date

Signed

Date

5/22/97

~~_____~~ Ti Mark 300 A

#1 5mb, 500/0w, 5 Cl₂/20 H₂, 5T, 8080, 40°
 → 10mb, 450/0w, 4 Cl₂/40 O₂, 60° 60° 9.5°

#2 5mb, 450/0w, 4 Cl₂/40 O₂, 120° -510V
 15.6° 300A etch?

#3 60° at 5mb No Ti etch
 72° at 10mb No Ti etch
 at 2nd Ti Bkth in 20° clear in 45°
 2844 w/Resist step

re-etch #2 at 5mb, 450/0w, 7 Cl₂/40 O₂, -800V
 1583A step. 120°

B1 5mb, 450/60, 7 Cl₂/40 O₂, 180° 1200A - 820V

3.5 mb, 500/0, 5 Cl₂/20 H₂, 60° Bkth. 105° -

Ti Mark (mistake) 3.5mb, 500/0, 5 Cl₂/20 H₂, 120° -580 1000V
 27.2A_{pp}

Ti Open 3.5mb, 500/0, 5 Cl₂/20 H₂, 55°

| | | | |
|------|------|------|----|
| | .2 | .0 | |
| 1.6 | 1.3 | 3.6V | PP |
| 10.8 | 10.1 | | |
| 9.2 | 8.4 | | |
| 1.6V | 1.7V | | |

Continued on Page _____

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Date _____

Signed _____

Date _____

60
PROJECT _____

Notebook No. _____
Continued From Page _____

6346A⁰ PR Starting [REDACTED]

10.7 11.0

1.7 mb, 800/140w, 5.4 Cl₂ / 10.2 HB₁ / 9.2 H₂

14.6 Ω
17 m Ω

Continued on Page _____

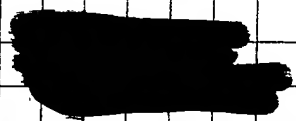
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→ Mask Ti check pattern @ 3.5 ml 55"

→ Check on 4 pt probe?

→ Test in HDT, PSC and 915

→ over bake Tests

| | | |
|------|------|------|
| | Q | F |
| 9540 | 8365 | 9380 |

9312

9100

9237

6/10/97

7000 (1200 A) total
1000 A
T_i

5mb, 500/0, 5 Cl₂/25 H₂, 60"

D7

PT

5mb, 450/60, 8 Cl₂/40 O₂, 90"

-780V Q2

956 A step 1000 A ears.

17000 (7000 miles)
D7

5mb, 500/70, 8 Cl₂/40 O₂,

180° -880V

#1 5mb, 500/0, 7 Cl₂/20 H₂, 90° didn't clean 4375 PR

Continued on Page _____

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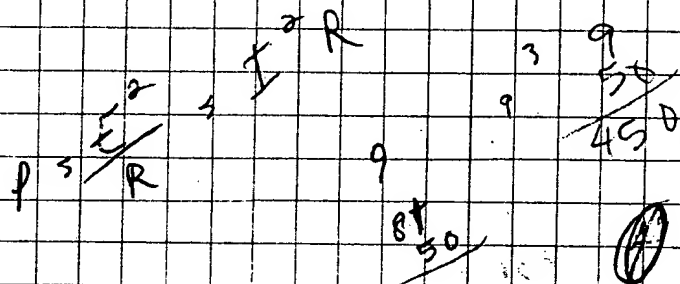
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Date _____

500W
448V
9A

μ -scope lens $\frac{1}{2}$ " 12mm CF PL 2.5X
outer Dia. (pen cap to ridge)

67 Ω



58 443
8.9 A

4.8 V 1600 V_{pp} KHz

0.9 V 1940 V_{pp} MHz

7.28 V₁₀₀ 2280 V_{pp} KHz 1640 MHz V₁₀₀

5mb, 500%, 100, 20A₁

| | | | |
|-------|-------------------------|-------|------------------------------------|
| SN 15 | 640 524 V | 8.8 A | 1.2 NS 1500V 29.6 -720VDC 16.8A |
| SN 28 | 472 V | 7.0 A | 1.6 NS 1080V 26.4A -752VDC 17.10S |
| SN 33 | 464 | 7.2 A | 1.8 NS 1320 VM 28.8 -780VDC 21.6NS |
| SN 04 | 880 V | 7.6 A | 0.8 NS 2140V 28.4A -760 26.0NS |
| | | | 2840V 33.6A -1240 27.20 |

10° 11.2 29.0
18° 5.3 32.0
40° 2.4
90° 2.0 mb
1.7

Continued on Page _____

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H1 5mb, 500/70, 8 Cl₂/400₂, 240° - 800 940K 1020M
26.4A 5+

D6 5mb, 500/0, 5 Cl₂/20HB₁, 70°EP 90° 5260A PR

6/13/92
E6 4mb, 500/0, 5 Cl₂/10 HB₁, 90° No Etch
5mb, 500/0, 5 Cl₂/20 HB₁, 60° 3500PR 500A raw

D6 5mb, 500/70, 10 Cl₂/400₂, 270° oxide!! 2100-
300A raw 2300A stop
5T

E6 Messed up 70° mark Arc etch

E6 5mb, 500/70, 10 Cl₂/400₂, 5T, 70° + -880V DC
2200VM 28.8A 1990KV

7mb 40° No Pkth.
E4 2nd 5mb, 500/0, 5 Cl₂/20HB₁, 70°

300A
A → D3 1st 5mb, 500/0, 5 Cl₂/20HB₁, 60° 20°EP 1880VM-580

360A F 5mb, 500/0, 5 Cl₂/20HB₁, 60° No Pkth.
4mb, 30° Pkth + 60° 12.1°V

300 D3 5mb, 500/70, 10 Cl₂/400₂, 240° .18μ Top .64μ Bottom
5T

600 E4 5mb, 500/50, 10 Cl₂/400₂, 360° .18μ Top 73° .28μ Bottom

Continued on Page

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Date

Etch (mask pre-etch)
Ti Layer
90" Blank strip
3 spl
per part, part strip
Etch 300 ft 90"
Etch 300 ft 90"

11.4
5.5
2.5

| | N | M | H ₂ O | M |
|-----------|-------|------|------------------|-----------|
| SN15 500W | 1220V | K | 31.2A | 18.0 |
| 200W | 1184V | | 33.6 | 17.6 |
| 500/100 | 1400 | 1560 | 32.8 | -1320 -DC |
| SN 50W | 1340 | | 28.0 | |
| 54 700 | 1560 | K | 31.6 | 20.0 NS |
| 500/100 | 1520 | 1560 | 32.8 | -1340 |

| | | | | | | |
|---------------------|------|------|-----|------|------|---------|
| SN ³⁵ 28 | -800 | 1280 | 883 | 280 | 9.21 | 17.2 NS |
| SN28 | -800 | 1280 | 895 | 28.0 | 9.30 | 17.6 NS |
| SN14 | -800 | 1520 | 942 | 28.0 | 9.31 | 14.4 NS |

| | | | | | |
|------|------|-----|------|------|-------|
| SN35 | 4.80 | 156 | 7.20 | 2.44 | 0 NS |
| SN28 | 4.72 | 160 | 7.59 | 2.55 | .4 NS |
| SN14 | 4.52 | 154 | 7.20 | 2.48 | 0 NS |

A 634 548 838
EP 587 510 837
F 716 -718 8.59A

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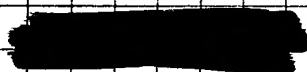
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PROJECT _____

Continued From Page _____

SN 75



6/18/97

A 6

5mb, 500/0, 500/200B, 90°

617A Aug

B 6

60°

F 6

5mb, 500/40, 1000/400, 240°

SN 14

| | | | |
|-----|-----|------|------|
| 320 | 109 | 6.16 | 2.10 |
| 400 | 138 | 7.84 | 2.72 |
| 472 | 162 | 9.28 | 3.21 |

ONS

SN 28

| | | | |
|-----|-----|------|------|
| 332 | 113 | 6.50 | 2.21 |
| 420 | 145 | 8.24 | 2.85 |
| 488 | 171 | 9.68 | 3.31 |

2 NS

SN 35

| | | | |
|-----|-----|------|------|
| 336 | 115 | 6.48 | 2.19 |
| 424 | 147 | 8.24 | 2.86 |
| 496 | 172 | 9.60 | 3.35 |

2 NS

300

300 W

SN 33

| | V _{pp} | V _{rms} | A _{pp} | V _{rms} |
|------|-----------------|------------------|-----------------|------------------|
| 300W | 328 | 113 | 6.72 | 2.28 |
| 500W | 420 | 144 | 8.56 | 2.92 |
| 700W | 488 | 168 | 10.0 | 3.47 |

4 NS

SN 15

| | | | |
|-----|-----|------|------|
| 348 | 123 | 7.04 | 2.46 |
| 444 | 152 | 8.96 | 3.07 |
| 516 | 181 | 10.5 | 3.65 |

ONS

V in connector
Bad.

SN 04

| | | | |
|-----|-----|------|------|
| 632 | 220 | 6.96 | 2.37 |
| 800 | 281 | 8.88 | 3.06 |
| 860 | 319 | 10.4 | 3.62 |

ONS

V Double
real #

Continued on Page _____

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Date _____

-80V 1100V_{pp} 28.8A_{pp}

Continued on Page

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Date

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Date

6/19/97

~~G8~~ 3.5 mb, 500/0, 5Cl₂/20H₂ 60"
 B7 5.0 mb, " " " 60" T: EP
 -620 670-880

A6 5 mb, 500/0, 10Cl₂/40O₂, 270°+120°
 -5700C 912V rms 632V 7.99A 17.2Ns

5 mb, 500/0, 15O₂/40Ar, 60" 2013A
~~G8~~ 5 mb, 500/0, 10Cl₂/40O₂, 206"

B7 5 mb, 500/40, 10Cl₂/40O₂ 360° -775 1780 819 8.51

F5 5 mb, 500/0, 5Cl₂/20H₂, 90° No Rkt + 0.4 mb 90°
 E3 " " " 20" Rkt EP +20°

Matrix Started

T: 6/25/97

11.0° Valve Angle
 5 mb, 500/0, 5Cl₂/20H₂, 60" 5 wfs
 50" 4 wfs
 45" 6 wfs

-680V 1100Vpp 28.8A

F0 B7 512/737
 E2 486/1833 A2
 D4 917/1528 E6
 G7 1112/1142 A1
 FL 1739/3050 D3 400/1733
 A7 814/2212 F6 spare

} smaller
wires

Continued on Page

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T5 4
T8 3
T10 7
T12 8

90.0

3.2

2.0

33.5

[Signature]

Continued on Page

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7/9/97

Cu

- ST T_{ex}#1 5mb, 500/120, 8Cl₂/60Ar, 200° Resist gone 2K step
- #2 5mb, 500/20, 12Cl₂/20Ar, 290° Resist gone sel. to low
- ST #3 5mb, 500/100, 4Cl₂/60Ar,
- DT #4 5mb, 500/200, 2Cl₂/60Ar, 300° Burned PR
- IT #5 5mb, 500/150, 2Cl₂/60Ar, 300° + 60° Some Burned PR (Best Etch)
- #6 Strip only Heavy OX. incamp. strip (1 hr. 915)
- 4" Cold DUV #7 5mb, 500/150, 2Cl₂/60Ar, 360° 2' steps wrinkled PR not clear.
- Cold DUV #8 5mb, 500/150, 2Cl₂/60Ar, 590° 3' steps wrinkled PR mod. Res.
- " #9 " " " " 300° 1 step wrinkled PR heavy Res. (more DE? not)
- #10 3.7 mb, 500/200, 2Cl₂/60Ar, 220° 300° Clear center.
- T#11 Wideopen 2.0 mb, 500/200, 2Cl₂/60Ar, 170° Not clear
- T#12 " " " " 210 180° clear
- 15" 90-150°C 240° High DUV
- T13 1.5 mb, 600/150, 5Cl₂/40Ar, 60° + 100° + 120° @ 15mb.
- T17 2.5 mb, 500/150, 3Cl₂/60Ar/60Ar, 220° + 100°

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3 1/2 : 1
4.5 : 30

30 Flow Constant
1 T. Clamp
90° O.E. Time

2:1 2 20A 10 HB
3.5:1 4 22.5 7 HB
5:1 6 28 4

30 10/20 2
30 6/24 4
30 4/24 6

245

43
7 30
28
20 25.8

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7/18/97

DØ 3 mb, 500/0, 8 Cl₂/20 A, ~~40~~ = 40" 5T

Ab " " " " 30" 1T

1T
Ab 3 mb, 600/100, 8/27, 120" + 80"

DØ " " " " 140"

— 5 mb, 500/0, 8 Cl₂/20 A, 50" 1T
— 55"

⊙

18° FI 3 mb, 600/100, 7/21, 140" EP + 60" 2287

17.0° C5 120" EP + 80" HB for Cl₂ 2245T/8 2.0 mb, 500/200, 2 Cl₂/60 A, 60" + 150"
+ 4 HB, ~~240~~ 240"A 4 3 mb, 600/100, 7/21, 130"
500/200, 0/7/21, 180"Need 2T
Clamp↑ HB killer may
need to use only 2 additionalEZ 3 mb, 600/100, 8/12/20, 130"
9.4% 6 mb, 700/100, 8/12/7, 130"Press A
Lower HB
No Cl₂ OE.

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4. BPA Veils

| | | | | |
|---------|-----|----------------|------|--------------------|
| 400 RT. | 800 | 1300 | 5600 | — |
| 300 RT. | 500 | 1300 | 1400 | FS |
| " | 800 | 900 | 1000 | FS A6 — |
| " | 800 | 1600 | 2300 | FS F0 |

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PROJECT _____

7/24/97

Ti Mask open

IT H₂ 80°/80°C 1st wf 70" 600A 3rd 55"

* 11.5° 5mt, 500/0, 8Cl₂/20H₂

E.P. over Pt at 519, 514, 503, 740 (rise)

2nd ? wf.

9th E.P. early 300A Ti?

E3 2mt, 600/100, 4Cl₂/12O₂, 120" 95°EP.
2mt, 800/200, 10HBr/20O₂, 110" Too Long

F6 " " 140" 105°EP.
" " 60"

300A Ab 5mt, 500/0, 10Cl₂/20H₂, 60" 800-1000

TI F0 5mt, 500/100, 5Cl₂/20HBr, 50" 800/1000 - 2300

IT

7/30/97

F0 3mt, 600/100, 4Cl₂/12O₂, 110"
2mt, 500/100, 10HBr/20O₂, 70"

F5 3mt, 600/100, 4Cl₂/12O₂, 120"
2mt, 600/0, 10HBr/20O₂, 60"

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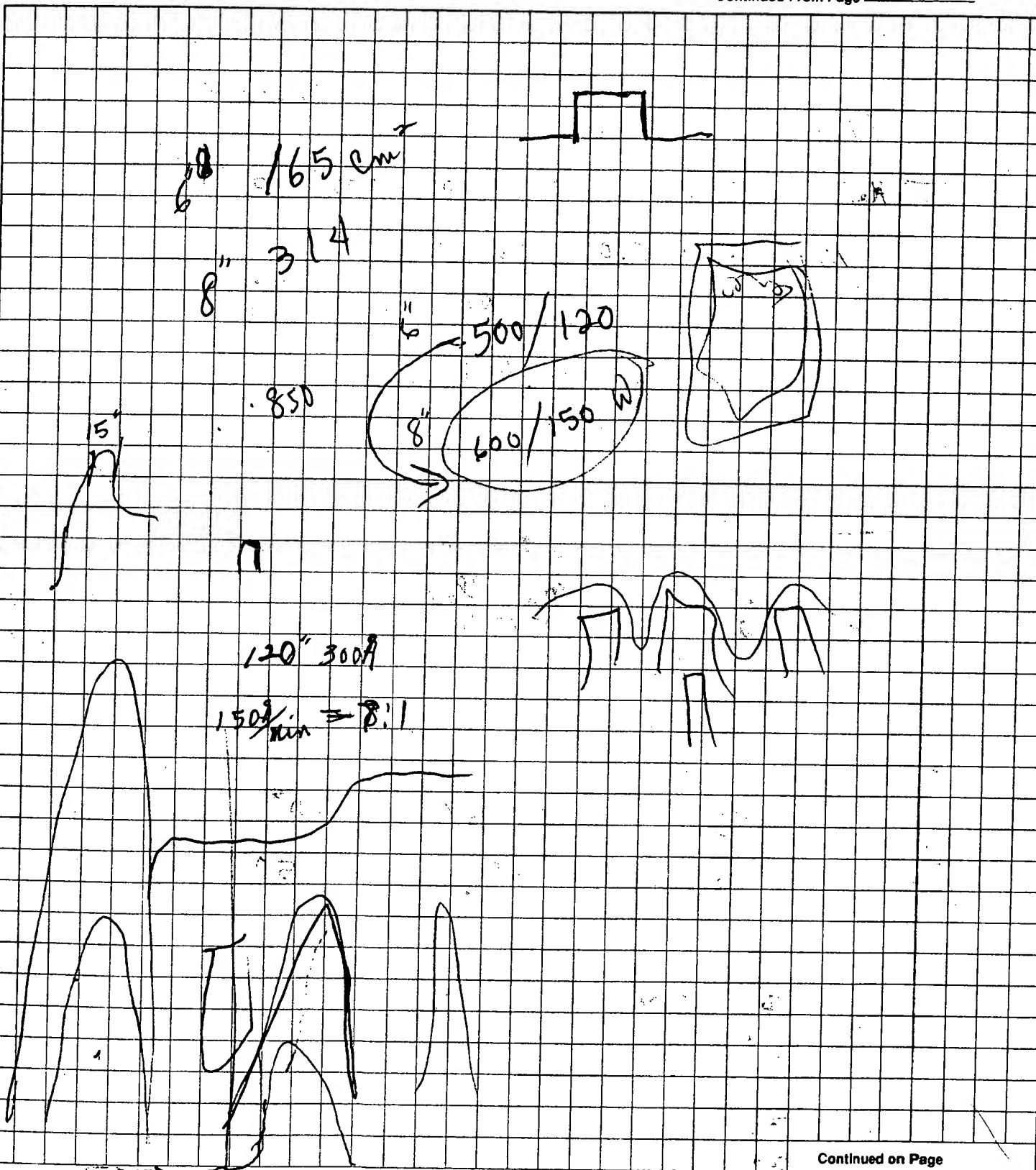
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7/31/97

A6 { 2 mb, 600/100, 7 Cl₂/21 O₂, 120°
 2 mb, 600/0, 10 HBr/20 O₂, 60°

B3 { 3 mb, 600/100, 7 Cl₂/21 O₂, 120°
 2 mb, 600/100, 10 HBr/20 O₂, 60°

3 mb, 600/100, 7 Cl₂/21 O₂, 120° Best - C5
 3 mb, 600/100, 7 HBr/20 O₂, 80°

✓ ~~Handwritten~~
 2 or 3 mb, 600/100, 7 Cl₂/21 O₂, 140° 2 or 3 mb
 3 mb, 600/100, 10 HBr/20 O₂, 90° 2 or 3 mb, 0 or 100 kHz, 60-120° DC

✓ { Ti 5 mb, 500/0, 10 Cl₂/20 Ar, 60° IT 80°/80°
 Maybe increase kHz from 0-100 W for cleaner PR + Vent. pt etch

most likely best process

5 mb, 500/0, 10 Cl₂/20 Ar, 60° IT 80°/80°

Strip

2 mb, 600/100, 7 Cl₂/21 O₂, 120°
 3 mb, 600/0, 10 HBr/20 O₂, 90°

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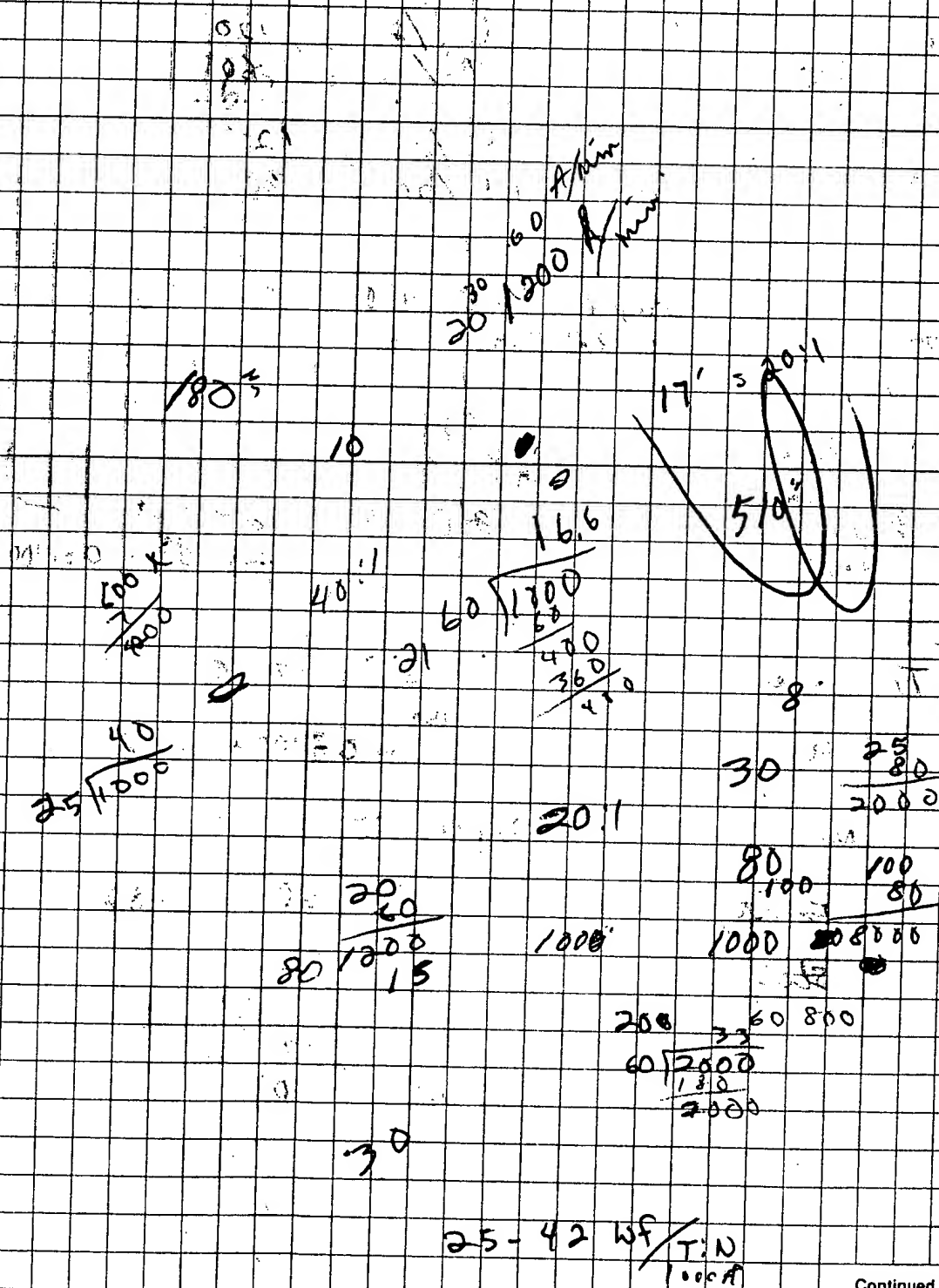
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Ran Blankets T.W.

1252 90° 5mb, 500/100, 10CH₂/20A, 60° clear T: 600 f

1325 100° 2mb, 600/100, 10HB₁/20D₂, 70° Pt clear 2100 f

120° 2mb, 500/100, 10HB₁/20D₂, ~ +180° +180° +180°

11'30" no meas. T:N loss

8'30" additional 2370 stop No T:N loss
2552 70°

T:N = 18 f/min

Pt = 1136 f/min

22

63:1

1 T:ID loss for 80° O.E. is est at 24 f

This would allow ~ 40 cycles
per T:N wafer of 1000 f.

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| | | | | |
|-------|-----|----------------|-----------------|----------|
| | 300 | 346 | 6.94 | |
| | 500 | 420 | 8.72 | |
| | 700 | 504 | 10.4 | 148 3.14 |
| SWATH | 300 | 324 | 6.03 | |
| | 500 | 400 | 8.00 | |
| | 700 | 456 | 9.40 | |
| SWATH | 300 | 340 | 7.04 | |
| | 500 | 420 | 8.7 | |
| | 700 | 504 | 10.5 | |

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|--------------|------------|--------------|------------|
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|--------------|------------|--------------|------------|

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Temp. Rise

on wafer in chamber $48^{\circ}\text{C} \rightarrow 65^{\circ}\text{C}$ with RF
 no change when wafer dropped

| | | | | | | |
|----------|---------|------|------|-------|--------|-------|
| | 300/0 | 700 | 18.0 | -396 | | |
| | 500/0 | 880 | 23.2 | -501 | | |
| | 700/0 | 1220 | 28.8 | -672 | | |
| 1.2N | 300/100 | 2160 | 22.0 | -767 | 1380 K | 960 M |
| 1.2 | 300/200 | 2820 | 22.0 | -1010 | 2120 | 1040 |
| 1.7W | 500/100 | 2060 | 26.4 | -777 | 1220 | 1120 |
| 3.6W | 500/200 | 2800 | 27.6 | -1030 | 1920 | 1240 |
| 3.6W Ref | 700/100 | 2140 | 30.4 | -836 | 1100 | 1320 |
| 3.8 | 700/200 | 2780 | 30.8 | -1050 | 1820 | 1420 |

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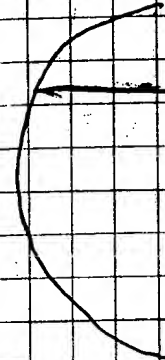
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9/25/97

5 mt, 500/100, 10 CL/20 A₁ HB 1st (2) 40 + 45° 50°

3 mt, 600/100, 7 CL₂/21 O₂, 60°
2 mt, 600/100, 10 HB₁/200₂, 120° 90°



1. No DUV w/Resist S/T: N S/No T: N
2. Etch w/ DUV mask no/pt
3. 150° 110 + 120
4. 5 mt O.E. No DUV

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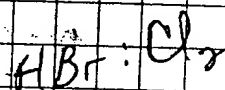
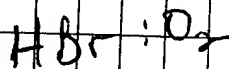
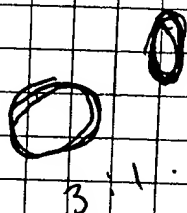
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50
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 100

28 4- 60
 0 25 50

| | |
|-----|-----|
| 450 | 750 |
| 500 | 600 |
| 50 | 100 |
| 150 | |
| 800 | 600 |
| 80 | 100 |
| 200 | |

| | | |
|-----|-----|-----|
| 450 | 600 | 750 |
| 50 | 100 | 150 |
| 450 | 600 | 750 |
| 0 | 75 | 150 |

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11/7/97

1200 A T:
 600 A T:N

5 mb, 500/50, 10 Cl₂/20 Ar, 70°
 55°^{EP} 11/8/80

T: 1000 3 mb, 600/100, 7 Cl₂/21 O₂, 60°
 25 2 mb, 600/150, 10 HBr/20 O₂, 240°

T: N 600 3 mb, 60°
 55 2 mb, 180°

T: 1000 5 mb, 400/0, 20 CF₄, 60° (10?)

10/8/97

1000 T: 5 mb, 500/0, 10 Cl₂/20 Ar, 65°
 600 T:N " " " 45°
 45°
 42°

600 A T:N 3 mb, 600/100, 7 Cl₂/21 O₂, 30°
 2 mb, 600/100, 10 HBr/20 O₂, 80° + 80° 180 A T:
 65 2 mb, 600/100, 10 HBr/20 O₂, 2 mb

1000 A T: " "
 26

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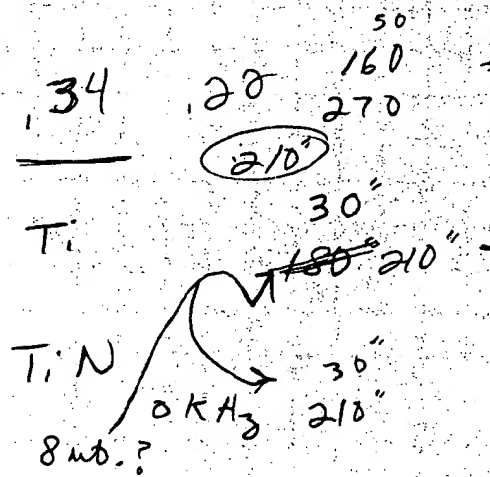
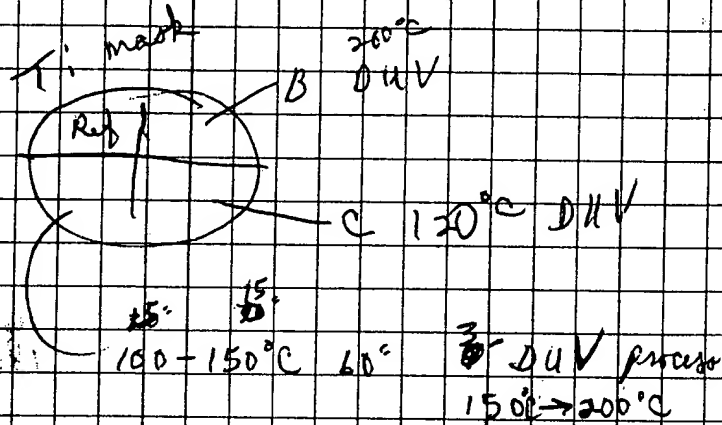
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PROJECT _____

6"
Ti Mask

10/9/97

#75 T.N

3mb, 600/100, 7 Cl₂/21 D₂,
2mb, 600/150, 10 HBr/20 D₂,
100

30"
65"
~~200~~
200

#27 T

11 700W

30"
~~200~~

50"
40"
60"

#28

3.0 mb, 600/100, 7 Cl₂/21 D₂, 30"
2.0 10 HBr, 20 210"

10/10/97

#29

8mb

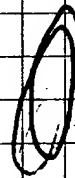
30
210

#88

3.0 mb
2.0 mb

/0

30
210



LG#2

5mb, 500/0, 15 Cl₂/30 H₂, 50"

LG

10/29/97

3mb, 600/180, 10 Cl₂/30 D₂, 30"
2mb, 600/120, 15 HBr/30 D₂/10 H₂, 130"

1870 V_{pp} 29.6 A_{pp}
- 609 V DC
Bias.

2mb, 600/120, 15 HBr/30 D₂/10 H₂, 180" (70° E.P.)

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10/29/97

LG

LG#3

5mt, 500/0, 10CL₂/20A₁, ~45°

3mt, 600/100, 10CL₂/30O₂, 30°

5mt, 700/100, 30HB₁/30O₂/10A₂, (E.P.+80°) 240°

O.E. 600
20R

180°

2460 V₁
33.6 A₁
-576
2/40V₁
30.4 A₁, +57

11/5/97

LG#4

5mt, 600/100, 15CL₂/30A₁, 50°

3mt, 600/100, 10CL₂/30O₂, 30°

5mt, 700/150, 30HB₁/30O₂, 270° No E.P.?

" " " " 180°

LG#5

5mt, 600/100, 15CL₂/30A₁, 50° 210° sand, 500/0, 45° OT

3mt, 600/100, 10CL₂/30O₂, 30°

5mt, 700/150, 30HB₁/30O₂/20A₁, 240° (20° E.P.) 120° Repet

2mt, 700/150, 15HB₁/30O₂/20A₁, 180°

Done!

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1 B
 5mb, 500/0, 10 Cl₂/20 Ar, 45"
 5mb, 200/150, 15 Cl₂/30 O₂/0 Ar, 215"
 5mb, 200/150, 10 Cl₂/200, 10 Ar, 180"

11/10/97

Resist

5200 Lge Feat. 4000 post
 1200 DUV 5130 " 4530 "

2 B
 5mb, 500/0, 10 Cl₂/20 Ar, 120" 3T 2370A Post
 " " 100 " " 180" 3T E.P. 3310A Lge Feat.
 5mb, 600/100, 20 HBr/30 O₂, 120" 3T 1381 Post
 3600 Lge Feat.

5mb, 500/0, 10 Cl₂/20 Ar, 80" 1T 3200A Post
 100 40" 3T 9200 Lge Feat.

3 B
 5mb, 600/100, 10 Cl₂/30 O₂, 30" 3T
 5mb, 600/100, 10 HBr/30 O₂, 160" 3T Not clear.

30" 3T Not clear on Ti?
 180" 3T 1800 Post
 2000 Lge Feat.

5mb, 500/0, 10 Cl₂/20 Ar, 30" E.P.
 100 60" 4000 post 9500
 60" 3600 post 4500

5mb 7 Cl₂/21
 2mb 10 HBr/30 O₂ 30" 2850 post 2830
 15 " " 45" 490"
 Continued on Page

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11/12/97

8" ESC

3mb, 500/0, 10Cl₂/20Ar, 30"EP, 45" IT
 5mb, 100, 7, 75" IT 4300R 4900R LG set
 2H .01A CO gain

10mb, 500/0, 450, 240" OT OV ESC 2750 1900 LG
 Left Tape. ~ 2700 PE etch
 1100R H remain.

3mb, 600/100, 7Cl₂/21O₂, 30" Rt Top 2700 2700
 5mb, 600/100, 10HB₁/300, 100" Mark to set 1.1 mb

5mb, 600/100, 10HB₁/300, 10Ar, 120" 2500 2650 LG

| | | | | | |
|------|------|-----|--------------|------------|--------------------|
| 4840 | 5148 | 1BA | No DUV | | 90° DUV Ramp start |
| 4750 | 5093 | 1BB | 90-120°C DUV | LG Process | 30 60 30 |
| 3731 | 4916 | 1BC | 90-200°C " | LG " | 30 60 30 |
| 2355 | 4782 | 1BD | 100-200°C " | B " | 30 240 30 |

90-200°C

0, 120°, 150°, 180°

90°C start 1°/sec

120 60" 30" 15"
 150 120" 60" 30"

180 180" 90" 45"

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Scale-up process?

3 mt, 700/100, 1000, 300, 30°
2 mt, 700/100, 20 MB, 400, EP

| | A | Ramp Time | Hold | DUV | |
|--------------|------|-----------|--------|-----|------------|
| 4MA 90°-120° | 30° | 15 sec | 45 sec | 60° | LG Process |
| 4MB 90°-150° | 60° | 30 " | 30 " | " | |
| 4MC 90°-175° | 85° | 42 " | 18 " | " | |
| 4MD 90°-200° | 110° | 55 " | 5 " | " | |

600/100 5 MB / 15'0"

800/200 15

~~800/200 5 MB / 15~~

600/100

1000A Diff dense to open.

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11/13/97

Right 3 mt, 100/100, 2 ~~100~~ / 21 O₂, 30°
 Tape 5 mt, 600/100, 10 ~~100~~ / 300 / 10 H₂, 240° (120x2) + 50°

#1 Left 5 mt, 500/0, 10 O₂, 30° BARC 150 A
 Tape 5 mt, 500/0, 10 O₂ / 200, 140° EP, 80° T: N 1000 R.

151 O.E.

120°

10°

50°

#2 M

30° BARC

20° I 80° T: N etch. 110° TH.

3 M

5451 A after 30° O₂ + 100° T: N 20° I, 16° RE.

1511 C

1622 R

1710 L Barc.

#2 M

3 mt, 600/100, 7 ~~100~~ / 21 O₂, 30°

3104 L

3 mt, 700/100, 15 H₂ / 450, 90°

3044 C

3347 R

120°

85°

65°

3820 C

3° 5°

3168 C

3875 R

+ 80°

3322 R

3945 L

+ 80°

3349 L

270

4 min.

1000

2500

3500

260° - 115 A min. Edge

198 A min. Center

160 A min. Mask

3, 5, 90° EX ER. Test.

B 5 8

610 700 800

100 150 200

5 10 15 H₂25 30 45 O₂

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560 A / pt

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6:50

Signed

Date

Signed

Date

3 mt, 200/100, 10 Cl₂/30 O₂

7/14 12/14
14/42 7/21
7/21 14/42
10/20
20/40

2 mt, 710/100, 20 HB₂/40 O₂

| | | | |
|------|---|---------|--------------------------------|
| 2 mt | + | 800/200 | HB ₂ O ₂ |
| 5 mt | | 600/100 | 5/15 ✓ |
| 8 mt | + | 400/200 | 15/45 |
| | | | 10/20 |
| | | | 20/40 ✓ |

3 mt, 600/100, 7 Cl₂/21 O₂

2 mt, 800/200, 5/15
20/40

5 mt, 600/100, 5/15
20/40

100' 60"
100' 2592 1050
2592 1050
2592 893

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3 mb, 700/100, 15 HB₁/45 O₂, 120° 83A 41A/min.

$\frac{250}{167}$ remain

T.N 2 mb, 800/200, 20 AB₁/40 O₂, 120° + 130° + 130° 450° 24A/min.

20 cl₂

7167A

PE F₂ 90°

90°

1741 L

45P

33

29P

80

40A/min

1811 C

1130A

25

29P

80

40A/min

1535 R

45P

59

29P

80

40A/min

35087

45P

51696

45P

525

5 mb, 600/100, 10 HB₁/200 O₂, 120° 350A/min. 8:1

5 mb, 700/100, 15 HB₁/45 O₂, 180° 3172 58A/min.

1050 L

1016 C

893 R

3/2959

786

493A/min 120°

65° Clear T.N.

8.4:1

58 1993

483

290

1700 30 $\frac{56}{1700A}$ 150/min 200

50:1

3M

3 mb, 600/100, 10 cl₂/30 O₂, 30°
2 800/200 20 HB₁/40 O₂, 130° E.P.

+120° 2E.

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2+5

15/45

80/100

33

33 R

2 mb 800/100, 15/45

5 mb 800/100, 20/40

2 800/200, 20/40
45 R

700

120

1030

100

8

100

15

1020

600 R

25/30 R T.D

1200-1500 ft

$$\frac{12.75}{240} = \frac{6.75}{x}$$

20" I

10" O.E.

240"

130"

280"

265"

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11/18/97

5mb, 350/0, 10 O₂, 20°
 5mb, 600/0, 10 Cl₂/20 Ar, 100° 20° Int. 10° DE.
 10mb, 500/0, 450₂, 30° Strip 120° Tot.

HBR MFC Failed

Small Feature wiped out

| | | | |
|----------------------|-------------|-----------|--------|
| 800/200 W | (23:1) | 800/100 W | 53 |
| 182 R | 48 min. T.N | 47 T | 17/192 |
| 92 C | | 42 C | 53/1 |
| 156 L | | 61 F | |
| 48 $\overline{1100}$ | | 3/150 | 867 C |
| 96 | | 3/50 | 812 L |
| 140 | | 17 | 1027 R |
| 3/430 | 1142 | | 3270 L |
| 3/143 | 1059 | | 502 |
| 58 | 1099 | | |
| | 3300 | | |

1000 $\frac{700}{1700}$ 2:1 T.N:PR 6600 A Pool T.N etch thickness

5mb, 600/0, 10 Cl₂/20 Ar, 130° 35° Bare 15° DE.
 1200 P more strip without O₂ 800° T.N.
 1571-1711 A after Ash 1 hr.

M6

3mb, 600/100, 10 Cl₂/30 O₂, 20°
 2mb, 800/100, 20 Ar/40 O₂, 170° E.P.

1044
 4026 C
 11303 906 R

+ 90°

25° BARC 4628 R 11/20/97
 5mb, 600/50, 15 Cl₂/20 Ar, 600° E.P. 30° O.E. 115° Tot.

M7

3mb, 600/100, 10 Cl₂/30 O₂, 30°
 2mb, 800/100, 20 Ar/40 O₂, 145°
 90°

Continued on Page _____

120°
 Read and Understood By _____

Signed _____

Date _____

Signed _____

Date _____

3 mb, 800/151, 154B, 450r

80CF / 80CF / 1150 / 225

5000 / 150

2000 / 100

Steve M. Zhang

140' No etch CF/10/30
100' etch CF/10/30
20' TOS: N

M next

Increase KHz mask open to 100-150-200W trench to bridge.

2 step etch 200W K Bulk Trench/mask/space
100W K O.E. etch

- 1 Pressure from 2 → 5 mb to open narrow space.

5 mb, 600/0, 10 CF, 20 A, 70"
5 mb, 600/0, 10 CF, 40 A, 30"

Continued on Page

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Date

12/4/92

8M

5mb, 600/0, 10Cl₂/20Ar, 130°3mb, 600/100, 10Cl₂/30O₂, 30°5mb, 750/125, 45HB₂/45O₂, 180°
130°

12/5/92

PC 1

5mb, 600/0, 10Cl₂/20Ar, 60° 50°E3mb, 600/100, 10Cl₂/30O₂, 30°3mb, 700/150, 45HB₂/45O₂, 120°

+30° → 5mb, 700/200, " " 180°

500W Ar = 60°

#119

5mb, 600/0, 20Cl₂/30Ar, 110°25° PARC 52° T.N
33° O.E.3mb, 600/100, 15Cl₂/40O₂, 30°5mb, 700/150, 20Cl₂/30O₂, 180°3mb, 800/100, 15HB₂/45O₂, 180°

E.P. St. N50°

35W Refl.

45W Refl.

Best Mask open

5mb, 600/0, 20Cl₂/30Ar,
50° Total

5mb, 700/150, 30/30

3mb, 800/200, 15/45

N110

3mb, 800/100, 30HB₂/30O₂3mb, 800/100, 40HB₂/40O₂3mb, 800/100, 30HB₂/30O₂

100 (+20°)

E.P. St.

Continued on Page

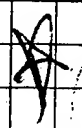
120° slope to 150° Total.

stood By

Signed

Signed

Date



| | 30' BARE | 45' BARE | PS 26 | 27 | 28 |
|-----|-------------------------------------|----------|-------|-----|----|
| 5mb | 600/0, 10CL ₂ /20A, 115" | 124" | 55" | — | — |
| 5mb | 600/0, 20 | 30 | 30" | 30" | — |

| PS 26 | PS 26 | M 11 |
|--|-------|------|
| 3mb, 600/150, 15CL ₂ /150, 30" | | |
| 5mb, 700/200, 45HB ₁ /450, 240" | 180" | |
| 5mb, 700/200, 15HB ₁ /450, 60" | | |
| 3mb, 600/150, 15HB ₁ /450, 180" | | |
| 5mb (M 11) | | 180" |

| PS 27 | M 12 | |
|--|-------|-------------|
| 5mb, 700/150, 20HB ₁ /200, 120" | 180" | |
| 5mb, 800/100, 30HB ₁ /300, 180" | 180" | |
| - 30μe | - 2μe | - 200 ESC V |

5mb, 600/0, 20/30 M.O.
 5mb, 700/150, 30/30 B.E.
 5mb, 800/100, 30/30 O.E.

5mb, 600/0, 10CL₂/20A, 20CL₂/40A,
 5mb, 750/200, 45HB₁/450₂
 5mb, 700/200, 15HB₁/450₂
 5mb, 600/0, 10CL₂/20A, BK
 5mb, 500/0, 15CL₂/30A, ME
 5mb, 500/50, 10CL₂/20A,

PS 30 M 13

| | | |
|---|-------------------|------|
| 5mb, 700/150, 20HB ₁ /200 ₂ , 110" | | |
| 3mb, 700/150, 10HB ₁ /10CL ₂ /10A/300 ₂ , 180" | Continued on Page | 180" |

PS 30 12/20/10/30
 M 13 10/10/10/20
 Read and Understood By

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